The Mysore Coffee Experiment Station—Bulletin No. 18.

DEPARTMENT OF AGRICULTURE
MYSORE STATE

Progress Report of work done on the Coffee Experiment Station, Balehonnur, for the period 1932 to 1936.

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FOREWORD.

Reports of work on the Coffee Experimental Station, Balehonnur, for the years 1925-30 and 1930-31 were published in the Mysore Coffee Experiment Station Bulletins Nos. 3 and 8, respectively. The enclosed report deals briefly with the work of the Coffee Experimental Station for the period 1932-36. The report has been prepared by Mr. K. H. Srinivasan, M.A., B.SC., Senior Assistant Director of Agriculture, Chikmagalur, who is in charge of the Chikmagalur Circle comprising the coffee area in Mysore. The manurial experiments on the Coffee Station are in charge of Dr. B. T. Narayanan, B.A., PH.D., D.I.C., Bio-Chemist of the Department and the Mycological work in charge of Mr. M. J. Narasimhan, B.A., Mycologist of the Department with the able collaboration of Mr. W. W. Mayne, Coffee Scientific Officer of the United Planters' Association of Southern India.

Work relating to a crop like coffee is one of very long range. The problems relating to coffee are being investigated here on the same lines as in other coffee experimental stations in other parts. Problems relating to testing of the progenies of selected mother plants, the possibilities of vegetative propagation and manurial treatment naturally take a very long period of years to produce results of value for ready adoption by planters. It may be as well here to remember what Dr. C. J. J. Vanhall has stated about the coffee selection work in the Netherlands Indies, in a recent article in the Tropical Agriculture. He states as follows :— "20 years is a short time for selection work especially when dealing with the perennial crop and we have not yet come to the point where we can claim that the experimental stations have ready to hand clones and seedling families to suit the exact needs of any and every estate that may apply for advice and assistance. But for all that there is reason to look with satisfaction on the work so far accomplished." I think these remarks hold good in respect of most of the Coffee Experimental Stations which are engaged in long range work on this crop.

BANGALORE,
7th Aug. 1938.

T. G. RAMA IYER,
Director of Agriculture.

THE MYSORE COFFEE EXPERIMENT STATION.

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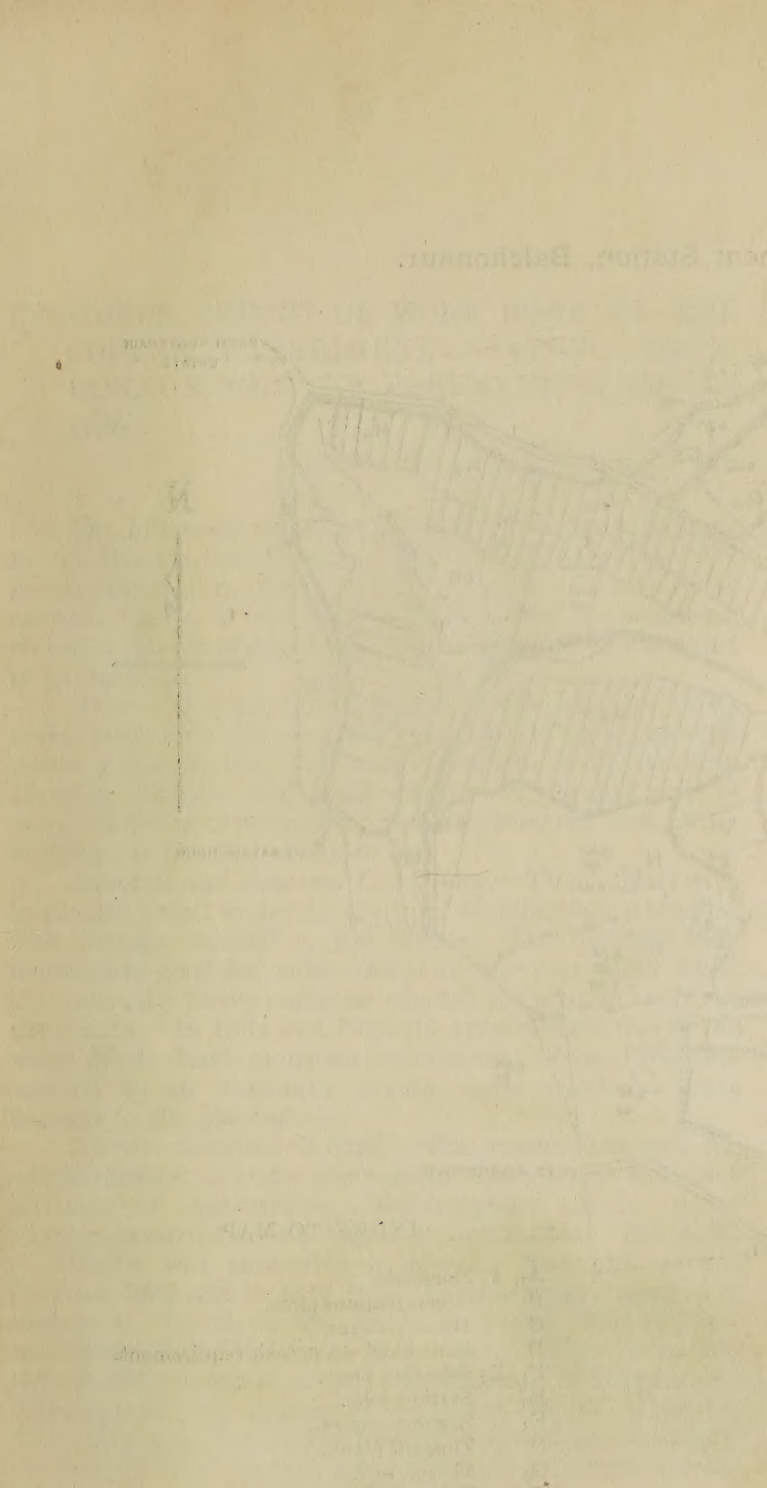
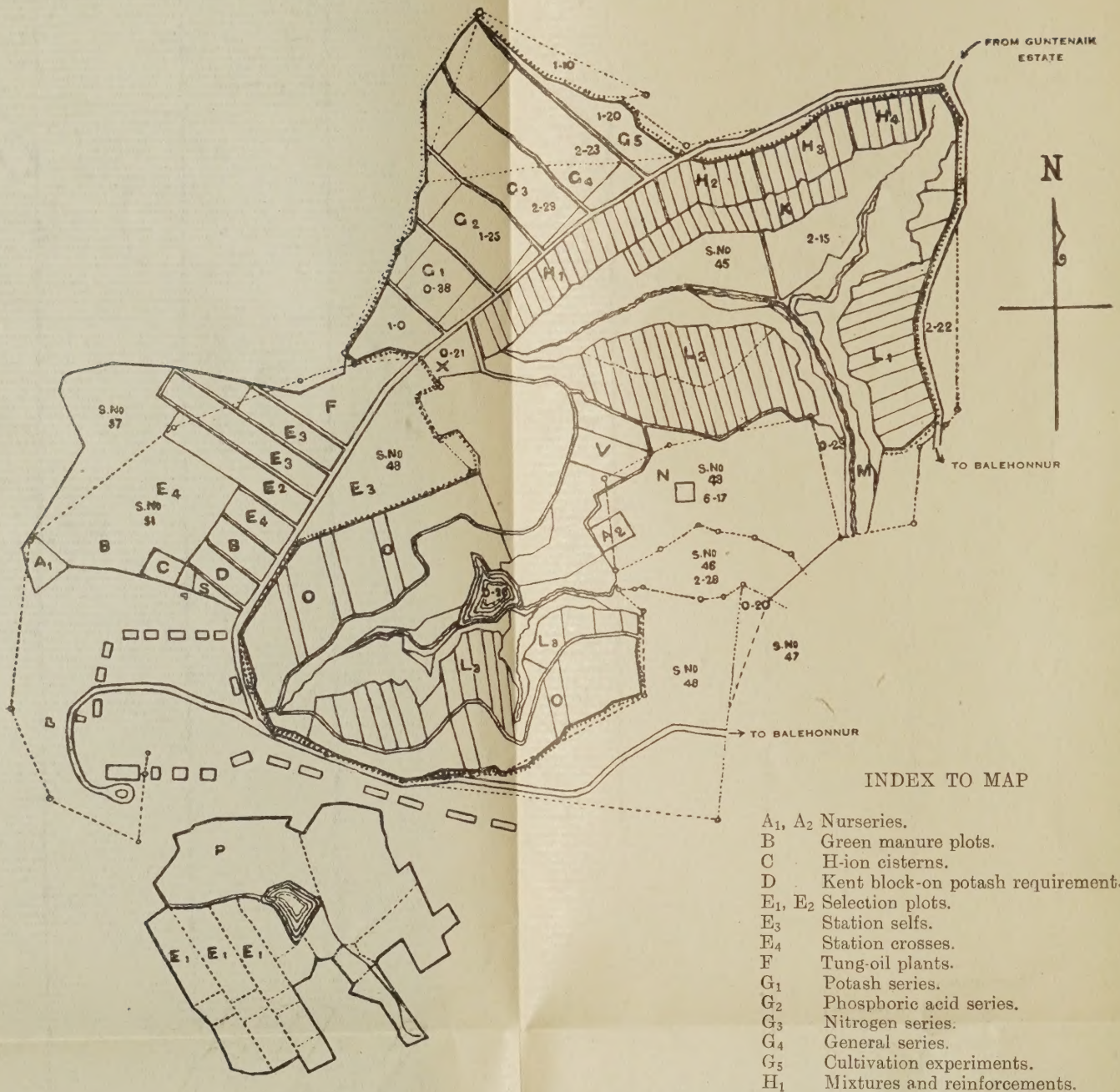
J. H. Sprott—Representative of the United Planters' Association of South India.
Dharmapravartha M. L. Nagappa Setty, Chikmagalur (Nominated).
Dr. G. M. Prabhu, (Ph.D.) Econ. (Berlin), Representative of the North Mysore Indian Planters' Association.



Map of the Coffee Experiment Station, Balehonnur.



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PROGRESS REPORT OF WORK DONE ON THE COFFEE EXPERIMENT STATION, BALEHONNUR FOR THE PERIOD FROM 1932 TO 1936.

The following report deals briefly with the work done at the Station from 1932 to 1936, work previous to 1932 being published in Bulletin Nos. 3 and 8. Reference to annual reports of the station submitted to Government, where in details of experiments are dealt with are indicated in parenthesis.

Area.—The area under mature coffee remains at 82 acres, same as in the previous years and 40 acres more are under young coffee consisting of selections in Arabica, Hybrids, Robusta and other species. A detailed map of area indicating experimental plots, Laboratory and other buildings is found in diagram I.

Rainfall and Seasonal Conditions.—This is dealt with in greater detail under Agricultural Meteorological studies. The average rainfall is 105 inches. The seasons were moderately good for coffee except in the year 1933 when the unusually heavy monsoon affected the general health of the plants. In 1934 and 1935 the crop suffered due to the weak North-East monsoon conditions. Year 1936 was marked by an unusually severe storm which did some damage to the plantations.

Administration and Staff.—The supervision and the administration is under the control of the Senior Assistant Director of Agriculture, Chickmagalur Circle. Some changes occurred in the Advisory Committee. Mr. A. E. J. Nicolls was succeeded by Mr. L. Newcome on 3rd October 1932 and in May 1933 the committee consisted of Messrs. C. Vasudeva Rao, G. V. R. Frend, Haji Mahommed Hussain and Sylvester Pais. Mr. L. Garret attended the meetings in place of Mr. L. Newcome. Mr. Bagamane Dyavegowda was appointed in place of Mr. C. Vasudeva Rao deceased. In August 1936, the Board was reconstituted and it now consists of Messrs. G. V. R. Frend, Sowcar

Mohammed Salar, *Dharmapravartha* M. L. Nagappa Setty, J. H. Sprott and Dr. G. M. Prabhu who was recently appointed. Mr. W. W. Mayne, Coffee Scientific Officer of the U. P. A. S. I., continues his scientific investigations on several problems connected with coffee with the co-operation of the staff of the Station. Besides, he has been helpful to the staff in various ways. The results of his work are published periodically for information of planters in the form of bulletins of the Coffee Experiment Station (*Vide* list of publications). The staff consists of the Manager, the Assistant Manager, Meteorological Observer, Plant Breeding Inspector, Grafter, Clerk, Mechanic, Fitter and Laboratory Assistant and a peon. The only additions are those of the Meteorological Observer and the Grafter in the years 1935 and 1936, respectively. The Meteorological Observer who has undergone training in Agricultural Meteorology, is employed to conduct meteorological studies in connection with coffee and other crops. An M.Sc. graduate in genetics was appointed as Plant Breeding Inspector in place of an Agricultural Inspector trained at Hebbal. The labour force continues to be 140 consisting of both Mysore and Ghat coolies.

Health of the Station.—The health of the Station has been fairly satisfactory. Cases of malaria and hookworm occur frequently. Medical treatment and facilities are adequate and satisfactory. The station water supply requires improvement both as regards quality and quantity during summer months. This improvement will be taken up very early.

Buildings.—Quarters for the staff and for the labourers have been inadequate and great difficulty is being experienced to accommodate the staff members, the labour force and the store articles. Alterations and additions to the existing staff quarters, the office and the school require to be immediately attended to. The construction of a permanent pulper house and vats in masonry in place of temporary arrangements is nearing completion.

Work of the Station.

(1) *Plant Breeding.*—Work on Plant Breeding has been carried on on the Station for the past eight years. Prior to 1929 seeds and seedlings were collected from several estates in South India and some Robusta and Liberica types from outside. These formed the foundation

stock for breeding operations. From 1929 onwards eighty mother plants have been selected. The basis for selection being high yield, uniformity and size of beans, vigorous growth and resistance to leaf rust disease. A plant breeding register is maintained in which detailed information regarding the mother plants is recorded.

Progeny tests are being conducted with the mother plants with a view to get like plants from seeds. For this purpose the mother plants are selfed and seedlings are raised from selfed seeds. Plants in this first generation are kept under observation : the yield record is maintained; the growth habit and resistance to leaf rust disease are observed. From among the families in the first generation plants that have retained the desirable characters of the mother plants are selfed to get the second generation. In this way it is hoped to build up pure strains for the desired characters. At present there are the second generation progenies of six mother plants.

From the information obtained about the mother plants it is found that some of them are more promising and hence, breeding work is being concentrated on these and their progenies. A few of the promising plants are: S. 48, S. 46, S. 26, S. 44, S. 31 and S. 53. (Plate 1 and 2) First generation progenies (plate 3, 4 & 5) of all of them and second generation progenies of S. 44 and S. 26 are growing in the field and are under observation.

Most of the eighty mother plants have been cross-pollinated with pollen from Kent and Coorg type of plants. Lately, some of the mother plants and their progenies have been cross-pollinated with pollen from Maragogype plants with a view to improve the bean quality of the mother plants. The plants from such crosses are young and are growing in the field.

The Station has collected a number of Robusta types from estates in Mysore and a few types were obtained from Ceylon. In 1935 some Java types were obtained through the courtesy of the Manager, Tea Estates of India, Ltd., Balehonnur. At present there are on the Station Robusta, Uganda, Quillou, Canephora, Liberica, Abeocuta, Excelsa and Congensis. Seeds of Congensis were brought from Java by Dr. Leslie C. Coleman when he had been there on deputation. All these different species and varieties are being utilised for breeding operations. Individual plant yield is being recorded for the several Robusta types.

Some Robusta plants have been selected as mother plants for their good formation, vigorous growth and high yield of big sized fruits. Their progeny by open pollination is being tried for progeny test. The mother plants have been selfed but they failed to produce seeds.

Many crosses have been effected using Robusta plants as male and female parents. " When Robusta plants are used as female parents and crossed with pollen from Kents, the Robusta plants do not set seed " (Bull. 8). However, when pollen from Robusta plants is crossed with Kent and Coorg type of plants seeds are produced. Plants from such crosses are growing in the field. Further work is in progress.

An experiment was started to find out whether pea berry seeds germinate as readily as flat bean seeds and, also, to study how the plants from pea berry seeds would behave. A number of pea berry seeds were sown and they germinated as readily as flat bean seeds. Next, a plot was laid out and planted out with seedlings from pea berry seeds. The plants are in bearing for the last three seasons. All the plants have produced flat bean fruits as well as pea berry fruits. Analysis of clean coffee obtained from this plot for the pea berry content has been made and for comparison analysis of clean coffee obtained from estate bulk has also been made. With the data available it is not possible to come to any conclusions. Further data is being collected and in the meanwhile, pea berry seeds from two plants in the pea berry plot have been sown with a view to find out the behaviour of the plants raised from them.

Table showing the percentage of pea berries from the clean coffee from the *pea berry plot and from the estate bulk*:—

Year	1933-34	1934-35	1935-36	1936-37
Per cent of pea berries in clean coffee from the pea berry plot.	Per cent Nil	Per cent 22·4	Per cent 40·3	Per cent 26·3
Percent of pea berries in the clean coffee from the estate bulk.	8	12·6	Nil	10·1

An analysis of fruits from individual coffee plants and as well as from different families in bulk has been made to

find out the pea berry content and the results have been tabulated.

Name of variety	No. of pea berries.	Wt. of pea berries in parchment.	Wt. of husk of 100 pea berry fruits.	No. of flat beans.	Wt. of flat beans in parchment	Wt. of husk of 50 flat bean f ruits.	Difference in the Wt. of parchment.	Difference in the Wt. of husk
		Grams	Grams		Grams	Grams	Grams	Grams
S. 26 ...	100	63·6	54·9	100	63·08	32·27	0·52	22·63
S. 66 ...	100	67·8	87·65	100	67·19	51·0	0 61	36 65
K'vurthy ...	100	47·3	43·7	100	44·71	23·66	2·59	20·04
Kent (Bulk) ...	100	52·18	54·9	100	51·3	29·87	0·88	25·03
357 (Bulk) ...	100	47·2	52·6	100	54·7	32·16	7·5	20·44
378 (Bulk) ...	100	41·7	46·35	100	53·0	30·87	11·3	15·48

From the table it will be seen that an equal number of pea berries show a negligible increase over the number of flat beans and, in the last two cases the weight of pea berries is markedly less than the weight of flat beans. Moreover, in all cases the weight of husk in getting 100 pea berries is more than the weight of husk in getting 100 flat beans. It will easily be understood that if the plant had produced as many flat bean fruits as it produces pea berry fruits then the resultant parchment would weigh about 50 per cent more.

Grafting of Coffee.—Among plant propagation methods grafting occupies an important place. The adoption of this method is oftentimes preferable to propagation by seeds when one is dealing with variable material. With a view to study the possibility of grafting in coffee culture experiments were started on the Station as far back as 1928. The work done from 1928-1932 has been published in Bull. No. 8. Further work done is herein stated in brief. It is proposed to publish a separate bulletin on grafting wherein grafting as applied to coffee culture will be dealt with in greater detail.

The advantages claimed for grafted coffee are many. But the particular advantages suitable to local conditions are yet to be studied. So far, the great advantage seems to lie in reclaiming bad patches by top working, *i.e.*, grafting on Robusta or Hybrid stocks in the field.

At first Robusta seedlings were being used as stock. Now, Netraconda and other hybrid seedlings are being used as they appear to be better suited. The scion wood is taken from suckers. Some grafts have been done using primary branches as scion material (Plate 6). All of these grafts appear to have the spreading habit whereas, grafts

with scion from suckers are growing vertically. Hence it appears that only suckers are to be used as scion to get vertically growing grafts. " The problem of ensuring an adequate supply of suckers for regular and periodical grafting on a large scale presents a practical difficulty " (1931). Experiments are in progress to overcome this difficulty.

Table No. II shows the number of grafts done and their success during the different years. Table No. III shows the percentage of success of grafts during different months in different years. From the table the optimum period for effecting grafts appears to be from February till end of August or September. (1932-33).

In the field unwanted Robusta and Hybrid plants are stumped during the dry season and two suckers per plant are allowed to grow from the stumped plants. When suckers attain the proper stage of maturity in the next year, one sucker from each stumped plant is used as stock and grafted with scion from high yielding Arabica plants. When the graft is successful the second sucker on the stumped plant is cut down; otherwise, the second sucker is utilised for grafting. Thus patches of Robusta and Hybrid plants have been converted into graft areas. This particular line of grafting in coffee culture has distinct possibilities in improving conditions in coffee estates with many bad patches.

Budding appears to be an easier operation than grafting though it is often said that the union between the stock and the scion in budded plants is loose and liable to be broken at the place of union during high winds. A few buddings have been done on Robusta and Hybrid stocks. Thirty plants have been planted in the field and they are developing.

Experiments were started in 1931 to find out the possibility of propagating coffee plants from cuttings. The programme included the study of proper time or season when success could be obtained and the choice of material, *viz.*, the kind of cutting to be used.

A definite number of cuttings were planted in nursery beds in each month. Nursery beds were prepared mixing up jungle soil and sand in the proportion of two of jungle soil to one of sand. The cuttings were from suckers of selected Arabica and Robusta plants. (Plate 7) Hardwood, semi-hardwood and soft wood cuttings were planted in the beds. The cuttings were from nine inches to one foot long and had two nodes. Table No. IV shows the percentage

of successful cuttings in different months, during the several years. Soft wood cuttings failed to callus and produce roots. With the hardwood and semi-hard wood cuttings successful results were obtained in the period from February till September.

In July 1934 a Solar Propagator was constructed and cuttings from suckers from selected Arabica and Robusta plants were planted. As the data collected is insufficient it is not possible to say whether the Solar Propagator is an advantage over nursery beds.

A few leaf cuttings with axillary buds taken from selected Arabica coffee plants were planted in the Solar Propagator during the first half of 1936. Out of 124 leaf cuttings planted only 15 slips produced roots. (Plate 8) They have been transplanted into a separate bed and are developing well. Further work is in progress to find out a method whereby leaf cuttings can be grown successfully.

Table No. I.

Statement showing the Selfing and Crossing work done on the Station from 1930 to 1936.

Year of Selfing	No. of plants selfed	No. of seeds got	No. of seedlings planted in the field	No. of plants crossed	No. of seeds got	No. of seedlings planted in the field
1930 ...	8	330	133	4	49	22
1931 ...	10	471	228	7	257	178
1932 ...	75	3,929	1,906	28	3,986	2,349
1933 ...	24	6,726	2,179	20	4,517	2,736
1934 ...	11	1,838	1,337	6	877	681
1935 ...	7	586	440	5	604	485
1936 ...	18	2,120	...	5	2,117	...

Table No. II.

Statement showing the total number of grafts done during each year in the Nursery and in the field and their success from 1930 to 1936.

Year	Nursery		Field	
	No. done	No. successful	No. done	No. successful
1930-31	1,594	877	478	346
1931-32	1,323	827	1,105	573
1932-33	1,110	562	800	304
1933-34	705	400	125	57
1934-35	760	389	50	Nil
1935-36	1,437	597	300	204

Table No. III.

Statement showing the percentage of success in grafting in Nursery and in the field from 1930 to 1934.

Months	1930-31		1931-32		1932-33		1933-34	
	Nursery	Field	Nursery	Field	Nursery	Field	Nursery	Field
October ...	1	...	20	49	36	9	3	...
November ...	34	53	14	20	23	8	...	...
December ...	42	...	40	...	37	6	...	...
January ...	53	...	42	...	45	...	...	...
February ...	70	100	76	11	72	28	...	...
March ...	68	100	84	74	77	65	78	...
April ...	50	54	96	87	79	69	74	...
May ...	72	100	88	92	84	65	83	...
June ...	76	93	70	94	80	64	42	...
July ...	90	76	72	34	17	26	85	92
August ...	60	56	84	68	39	38	68	80
September ...	35	70	52	53	18	40	48	56

Table No. IV.

Statement showing the percentage of success of coffee cuttings planted in nursery beds in each month from 1932 to 1936.

Months	1932-33		1933-34		1934-35		1935-36	
	Arabica	Robusta	Arabica	Robusta	Arabica	Robusta	Arabica	Robusta
August ...	20	60	36	40	...	...	...	...
September ...	8	24	24	32	...	...	...	...
October ...	12	8	12	20	...	...	...	...
November ...	4	..	...	4	...	...	...	...
December ...	4	4	...	4	...	...	...	...
January ...	...	20	...	...	...	...	...	36
February ...	36	56	10	...	...	...	88	52
March ...	60	68	60	50	...	...	40	64
April ...	60	68	90	85	...	...	44	40
May ...	60	52	90	95	...	...	32	56
June ...	44	24	35	85	36	8	44	12
July ...	4	80	35	70	...	...	20	30

Manurial and other chemical experiments.

Manurial experiments on the Government Coffee Experimental Station were primarily designed to find out the average manurial requirements of coffee and the most suitable combination of the several plant foods to give a good yield of the commodity of high quality. These experiments were intended not so much to stress the need

of manuring for coffee—for as is well-known, coffee manuring in some form or other has been a well established practice since the beginning of the coffee industry—as to devise a system of organised and balanced manuring.

It is necessary at the outset to state that manuring does not necessarily mean the application of fertilizers which it has unfortunately come to mean due to the very wide advertisement that these chemical fertilizers have secured of recent years. Manuring—in its simplest and therefore, the best sense—means application of requisite plant-foods in some well defined form, be it organic or inorganic. The experiments to be described were therefore trials in that direction.

The first experiments with coffee were started on an existing estate having plants as far as possible of similar size and vigour. The plots were laid in strips consisting of a dozen rows of 20 bushes each, and every 5th such plot was treated as a check and there were usually 3 such replications. The influence of a complete mixture or of the combination of two or of one alone of the three principal plant foods N, P and K on the yield of coffee were tested. In another range, trials were conducted using different forms of the three plant foods to find out the most suitable and the most responsive form of these in a complete mixture for a good yield of high quality coffee.

As a result of these trials, it was observed that Coffee did respond to a balanced system of manuring as evidenced from the improvement in the appearance of the bush and the marked, though very slight, increase in crop yields and the more uniform setting to hard beans. While these results were sufficiently encouraging, it was felt that precise information as to the physiological and economic implications of these results was lacking in view of the very wide lay-out of the plots, the treatments being in continuous strips, there being no division between any two treatments. It therefore happened that in the original lay-out there was, in addition to the influence of the normal variants, the super-imposed influence of one treatment over the other. Certain modifications in the lay-out were therefore introduced at the beginning of 1932 and completed during the two following years.

Trenches were dug in between the treatments, and the central blocks in each treatment comprising 6 or 8 rows of 20-30 bushes each were further isolated by

additional trenches. All the plants under treatment were manured and harvested individually, the yield from each row being recorded for purposes of calculation. The results of harvest were then calculated both on the basis of the central blocks and the whole of the experimental plot.

Tables I and II-A, B and C summarize the average yield per acre of crop from these experiments. The first one deals with general manurial requirements of coffee wherein the complete mixture and the omission of one or two of the three plant foods were tested. In the second, Nitrogen, Phosphoric acid and Potash were tested in their several forms to find out the most suitable form of each plant-food. Seven hundred and twenty bushes of coffee, divided at stated intervals into three replications of 240 bushes each were under trial, except the check where 960 bushes in four replications of 240 bushes each were under test. There were twelve rows of 20 bushes each for every replication. Cross trenches were dug between the tenth and the eleventh bush and dividing trenches between the third and the fourth row and again between the ninth and the tenth row. Each row was picked separately as stated earlier, such a system being confined to the first cross-trench, the rest of the 120 bushes being picked as a bulk crop. Calculations were then made both for the central ' blocks ' consisting of four rows of ten bushes and also for the whole block consisting of 120 bushes. The average yield from all the replications was then calculated to the acre.

In all these experiments except where indicated, Nitrogen was supplied in the form of groundnut oil cake, Phosphoric acid as Superphosphate of lime and Potash as an equivalent mixture of muriate (chloride) and sulphate of potash. As a result of certain physiological studies to be described in brief later, the dosage of manure mixture was given as 20 lbs. of Nitrogen, 30 lbs. of Phosphoric acid and 60 lbs. of Potash for every acre of 1,200 bushes of coffee. It is to be emphasized here that all these mixtures are *addenda* to the leaf mulch and such other organic matter incidental to coffee estates, so that the experiments are in effect, tests on what constitutes the best addendum to coffee under existing conditions.

While these experiments were in progress, it was noticed that plant variation and fertility gradients in the experimental plots were very marked and therefore affected

the yield figures to a not inconsiderable extent. New trials were therefore commenced early in 1934 on plants of the same age and belonging to, as far as possible, one variety (Kent's Arabica) in small representative blocks. There were 64 plants in each treatment with 3 replications each and the same precautions as regards isolation of treatments were observed. General manurial and the potash requirements of coffee were both tested. Average crop yields from these plots for the two full seasons of experiment are given in Tables III A and B.

It must be admitted at once that the trials, as is evidenced from the tables, are not conclusive for they do not, by the very nature of their lay-out, respond to a strictly statistical interpretation. It is however seen from a general analysis that coffee responds satisfactorily to an application of a complete mixture whose effect is cumulative and lasting whereas the effect of single plant foods, like Nitrogen alone, is merely stimulative and often erratic. Though no single formula can be fixed as a standard, the suggested mixture of 20 lbs. N, 30 lbs. P_2O_5 and 60 lbs. K_2O is helpful under normal conditions of soil and crop. Furthermore, there are also indications that a judicious combination of both organic and inorganic manures is more conducive to the well-being of the plant due to, no doubt, the more stimulative and therefore more exhaustive nature of the latter.

During the period under report, experiments were also conducted in a similar manner on the time of application of these plant foods, especially Nitrogen. Results are again inconclusive, though there is a slight improvement in yield where application of manures is made at or about the time of the blossom showers.

Experiments on the application of heavy doses of manure were conclusively against such applications, the yields being disproportionately poor. As a result of these trials, more rigorous experiments, based on statistical sanction, have been planned and it is hoped to have these working early. Seedlings from one selected parent of high yield and good quality and vigour are being raised, and will be transplanted in a piece of land of known fertility under strictly controlled conditions. The trials here will include the testing of the effect of the leaf mulch by itself alone so that the cumulative effect of such a natural source of *manure* may be included in any effective scheme of organized manuring.

Other chemical experiments.

(i) *Studies on the composition of the coffee bush and the berry from blossom to bean.*

It needs no emphasis to state that for devising a proper system of manuring a knowledge of the in-take and absorption of the essential plant-foods by the plant is as important as a knowledge of the soil and the climatological and environmental conditions. Analysis of the different parts of the plant, from a well-organised selection, and analysis of the crop from the spike to blossom and the set-bud to the blossom again were conducted over the full cycle of a year. The results of these are being discussed in detail in a Technical Bulletin. It may however be stated in brief here that a large amount of potash is acquired and stored in the spike and the blossom prior to setting and that this potash seems distributed as the berry developed after setting, thus emphasizing the physiological necessity of an adequate supply of this plant food. The phosphorous requirements, on the other hand, remain at a uniform level being about 1/5 of the Nitrogen content. As is to be expected, coffee requires a steady and increasingly available supply of Nitrogen throughout the course of its development, the maintenance of the Carbo-hydrate Nitrogen ratio in the plant, being a condition of this supply. It is gratifying to observe that the proportions of plant-foods now advocated is well supported by physiological observations.

(ii) *Soil conditions for growth of coffee.*

Pot experiments on the optimum soil condition for a good growth of coffee had shown that coffee grew best when the reaction of the soil was somewhere about neutrality, being about PH 6·5 to PH 7·0. Though it is difficult to simulate these results in natural soils, due to the enormous buffering action, it is observed from tests over a few thousand sample of soils over practically the whole of typical coffee growing areas in Mysore and Coorg, that, provided all other conditions are normal and cultural operations are satisfactory, bushes which have gone off condition do happen to stand on an acid soil. The system of liming which is so well-known an emperical method with planters, thus finds a happy confirmation from scientific data. It should however be emphasized that

liming should under no condition be undertaken without a preliminary testing of the soil. For, be it emphasized, liming a soil when it is not required is just as, and perhaps more, harmful as not liming it when it is required.

GOVERNMENT COFFEE EXPERIMENT STATION, BALEHONNUR.

Table I.

General manurial requirements of coffee.

17-acre Block.

Treatments	Particulars	Yield of ripe cherry in lbs. per acre			
		1932-33	1933-34	1934-35	1935-36
Check (no addendum)	Average yield per acre	2,442	1,652	1,166	1,111
	Average yield per acre from the middle four rows.	...	...	1,165	1,177
N+P+K	Average yield per acre	3,041	1,766	1,767	1,579
	Average yield per acre from the middle four rows.	...	...	1,850	1,775
Cake+Super (N+P)	Average yield per acre	2,563	1,631	1,794	1,693
	Average yield per acre from the middle four rows.	...	...	1,547	1,730
Cake+Potash (N+K)	Average yield per acre	2,634	960	1,230	1,342
	Average yield per acre from the middle four rows.	...	...	1,210	1,365
Super+Potash P+K	Average yield per acre	2,135	1,091	1,603	1,442
	Average yield per acre from the middle four rows.	...	...	1,535	1,552
Cake (N)	Average yield per acre	2,986	1,734	1,626	2,004
	Average yield per acre from the middle four rows.	...	...	1,682	1,975
Super (P)	Average yield per acre	2,499	1,430	1,021	1,221
	Average yield per acre from the middle four rows.	...	...	937	1,350
Potash (K)	Average yield per acre	2,127	1,127	1,367	1,232
	Average yield per acre from the middle four rows.	...	...	1,371	1,320

NOTE.—New manurials were started in 1932. Yields have been calculated from the middle four rows also to minimize border effects.

GOVERNMENT COFFEE EXPERIMENT STATION, BALEHONNUR.

Table II.

Yield of coffee in relation to manuring.

A. Trials on the influence of different forms of Nitrogen in a complete manurial mixture.

17-acre Block.

Treatments	Particulars	Yield of ripe cherry in lbs. per acre			
		1932-33	1933-34	1934-35	1935-36
Check (no addendum)	Average yield per acre	2,879	1,907	1,495	961
	Average yield per acre from the middle four rows.	...	...	1,406	990
Cake	Average yield per acre	2,669	1,475	1,856	831
	Average yield per acre from the middle four rows.	...	...	2,047	977
Am_2SO_4	Average yield per acre	3,273	1,785	1,996	1,155
	Average yield per acre from the middle four rows.	...	...	2,402	1,185
$NaNO_3$	Average yield per acre	3,386	1,060	1,866	957
	Average yield per acre from the middle four rows.	...	...	1,967	1,007
Nicifos	Average yield per acre	3,554	2,036	2,062	1,250
	Average yield per acre from the middle four rows.	...	...	2,482	1,395

B. Trials on the influence of different forms of phosphoric acid in a complete manurial mixture.

Check (no addendum)	Average yield per acre	2,884	2,166	2,381	1,026
	Average yield per acre from the middle four rows.	...	...	2,322	1,162
Steamed Bone	Average yield per acre	3,000	1,847	1,575	840
	Average yield per acre from the middle four rows.	...	...	1,560	877
Slag	Average yield per acre	3,289	1,383	2,206	778
	Average yield per acre from the middle four rows.	...	...	2,315	717
Super	Average yield per acre	3,604	1,864	1,818	600
	Average yield per acre from the middle four rows.	...	...	1,810	527

C. Trials on the influence of sulphate or chloride of Potash in a complete manurial mixture.

Check (no addendum)	Average yield per acre	3,114	948	2,421	562
	Average yield per acre from the middle four rows.	...	...	2,267	597
Kcl	Average yield per acre	3,365	1,238	2,342	714
	Average yield per acre from the middle four rows.	...	...	2,628	738
K_2SO_4	Average yield per acre	3,111	1,127	2,277	702
	Average yield per acre from the middle four rows.	...	...	2,328	840

NOTE.—New manurials were started in the year 1932. Yields have been calculated from the middle four rows to minimize border effects.

Yield of coffee in relation to manuring.

Trials on the influence of potash on yield.

Year of start of experiment 1934.

Kent b. s. q. Block.

Treatments	Particulars	Yield of ripe cherry per acre in lbs.	
		1934-35	1935-36
Check (no addendum)	Average yield per acre	1,040	1,960
	Average yield per acre from the middle four rows.	853	2,006
N+P+K	Average yield per acre	1,018	2,976
	Average yield per acre from the middle four rows.	934	2,687
N+P	Average yield per acre	1,672	2,875
	Average yield per acre from the middle four rows.	1,825	2,815

Kent b. c. l. Block.

Trials on general manurial requirements.

Check (no addendum)	Average yield per acre	233	1,298
	Average yield per acre from the middle four rows.	193	1,314
N+P+K	Average yield per acre	276	1,589
	Average yield per acre from the middle four rows.	285	1,350
N+P	Average yield per acre	195	1,567
	Average yield per acre from the middle four rows.	167	1,738
P+K	Average yield per acre	194	1,407
	Average yield per acre from the middle four rows.	189	1,353
N	Average yield per acre	435	1,410
	Average yield per acre from the middle four rows.	356	1,447
K	Average yield per acre	228	1,201
	Average yield per acre from the middle four rows.	332	1,193

Control of Fungus Diseases.—Coffee is subjected to attacks of Leaf Disease (*Hemileia* Vastatrix), Die-back and Black-rot of which the first two are the most important. In addition, some trouble is experienced from root rots usually associated with Fomes noxius, leaf spot (Cercospora coffeicola) and damping off of seedlings is occasionally noticeable in nurseries and pink disease (Corticium Salmonicolor) occurs sporadically in the old coffee.

Special measures are only required against the first three diseases mentioned and in some areas against root rots. The other diseases mentioned are of small importance or are easily dealt with by simple cultural measures.

The disease situation is nearly always dominated by attacks of leaf disease which is the greatest single cause of loss of crop and deterioration of the trees. Die-back is usually associated with and preceded by Leaf Disease. The severity of the attack varies from year to year in response to variation in climatic conditions and the health and the productivity of the trees.

Attacks of Black-rot are limited to the sheltered portions of the estate where they may do locally serious damage.

The control of both these diseases has been obtained by spraying with Bordeaux mixture. The value of this measure had been shown prior to the commencement of the Station but a great many points required fuller elucidation and experiments to this end were among the first to be laid out in the area acquired in the year 1930. Experiments to provide information on the value of adhesives and spreaders, the best strength of mixture and the most suitable time of application were commenced in 1930-31. From time to time, studies of various spraying outfits were undertaken. The results of these experiments up to 1932-33 were exhaustively dealt with in Bulletin No. 9. Since that date experiments have been continued along the same lines. Data are therefore available for six to seven seasons, and afford basis for a number of definite recommendations and at the same time indicate several new problems for future work.

Adhesives and Spreaders.—On the basis of experience gained with arecanut spraying and in view of heavy rainfall conditions in coffee areas, the use of some form of adhesive or spreader was considered desirable. In order to place this recommendation on a sound basis, experiments were set up to study the value of adhesives. The following adhesives have been tried on this Station :—

Adhesives.	*Years.*
Casein ...	... 1930 to 1936
Linseed Oil ...	... 1930 to 1936
Resin Soda ...	... 1930 to 1936
Gingelly Oil 1 per cent	... 1933 to 1936
Do ¼ per cent	... 1934 to 1936
Groundnut Oil 1 per cent	... 1934 to 1936
Hongey Oil ¼ per cent	... 1934 to 1936
Gingelly Oil ½ per cent	... 1934 to 1936
Molasses ½ per cent	... 1935 to 1936
Hongey Oil ½ per cent	... 1936.

Since 1931 plots sprayed with bordeaux without an adhesive have been included along with others receiving bordeaux with an adhesive. Control plots receiving no treatment of any sort were instituted as checks. In order to study the effect of these treatments, two types of data are available (*a*) the actual yield obtained, (*b*) the estimates of leaf retention and percentage of infection—recorded by Mr. Mayne, Coffee Scientific Officer of the U. P. A. S. I., the technique of which is described in Bulletin No. 5, page 16.

It is convenient in the first place to examine the data from the plots which have been under the same treatment continuously since the beginning of the experiment. The table below (*a*) contains the yield from these treatments for the years 1930-31 to 1935-36.

(*a*)

Treatment	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
No adhesive bordeaux	1,030	2,183	2,939	4,131	270	2,562
Casein bordeaux ...	1,030	3,052	2,843	3,770	361	2,351
Linseed Oil 10 ozs. ...	5,630	2,659	2,830	3,047	573	2,789
Resin Soda Bordeaux	566	2,575	3,079	2,532	707	3,070
Check (average of all)	787	1,119	861	1,261	555	614

In table (*b*) the leaf retention data is shown for the same period. These observations are made at the end of September in each year and represents the number of leaves per shoot on the branches examined.

(*b*)

Treatment	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
No adhesive bordeaux ...	Nil.	5·40	5·60	3·56	4·91	6·75	4·99
Casein Bordeaux ...	5·90	6·19	5·84	3·50	4·89	6·28	Nil
Linseed Bordeaux 10 Ozs.	6·35	6·28	5 93	3·23	4·49	6·42	4·91
Resin Soda Bordeaux ...	5·50	5·94	5·94	2·75	5·15	6·61	Nil
Checks ...	2·40	3·13	4·27	1·72	2·20	4·76	2·38

As far as the yields are concerned the differences are very small and are quite insignificant and the only year with large difference in favour of the adhesive was in 1931-32. This difference is due to the previous history of the plots. In the remainder of the years the differences are small sometimes favouring the plain bordeaux and sometimes one or the other of the adhesives. The mean yield for the years 1932-33 to 1935-36 show no signs of an appreciable advantage from the use of any one of these adhesives. The data from leaf counts point in the same direction; only in 1931, there is a small significant difference in favour of casein or linseed oil bordeaux over plain bordeaux. In other years, the differences have been quite insignificant.

Turning now to the materials in use for shorter periods, it is very difficult to draw any definite conclusion, but there are no indications at the moment that these materials will prove any more effective than those already discussed. The great difficulty in interpreting results lies on the influence of the preceding treatments on subsequent yields.

Treatments	1933	1934	1935	1936
Gingelly Oil 80 ozs.	3·66	5·49	6·80	...
Do 20 ozs.	...	5·06	6·02	...
Groundnut Oil 20 ozs.	...	5·41	6·28	...
Hongey Oil 20 ozs.	...	5·39	6·77	5·34
Molasses	...	...	6·33	5·19
Gingelly Oil 40 ozs.	...	5·84	6·92	5·67
Groundnut Oil 80 ozs.	...	5·42	6·39	5·92

In the case of leaf count data, again there are no very clear indications in favour of these adhesives or spreaders. The present position indicates that the value of the adhesives or spreaders added to Bordeaux for the control of the leaf disease has been over estimated. While it cannot be said that the adhesives or spreaders do not improve the physical characters and adherence of the fungicidal film, it must be admitted that their use does not lead to any noticeable increased yield or improved control of the disease under our conditions.

Other fungicides than Bordeaux.—In addition to the work with the bordeaux mixture a number of parallel tests

have been made with other fungicides. These include Solbar, Bouisol, Sulph-emulsol and Burgundy mixtures. Results for the first three of these were very poor and their cost was considerably higher than home-made Bordeaux mixture tests and hence were discontinued.

Burgundy mixture which differs from Bordeaux only in the substitution of soda ash for quick lime has given fairly good results. It does not seem however, that it is as good as Bordeaux mixture. A comparison of yields as given in table below shows that on the whole they favour bordeaux sprayed plots.

Treatment	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Linseed Oil 10 ozs. Bordeaux.	563	2,659	2,830	3,047	573	2,789
Fish Oil Resin Soap Burgundy.	787	1,807	2,114	2,304	712	2,672

The leaf count data show little or no difference between the two treatments as can be seen in the table.

Treatment	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36
Linseed Oil 10 ozs. Bordeaux.	6·35	6·28	5·93	3·23	5·49	6·42
Fish Oil Resin Soap Burgundy.	5·57	5·66	5·99	3·37	5·46	6·61

It may be said therefore, that Bordeaux mixture provides the most satisfactory fungicide for the control of the disease.

Strength of Spray.—The original strength of spray recommended was a 1 per cent mixture consisting of 5 lbs. of copper sulphate, 5 lbs. of lime in 50 gallons of water and experiments were started in 1931 to study the

possibility of reducing the strength to ½ per cent. Experiments were designed to compare the two strengths and at the same time to study the time of application. Restricting attention for the moment to comparison of strengths, 3 pairs of plots are available. (1) Sprayed in May and September, (2) in May only, and (3) in September only. Owing to positional variation, the yield data for the five years are given in table together with the yields of the neighbouring control plots.

Treatment	May and September	May only	September only
½%	2,525	2,007	1,600
Control	1,413	1,344	1,231
1%	2,224	2,101	1,408
Control	1,492	1,336	1,250

An inspection of these data, shows clearly that no advantage has resulted from the use of the stronger spray. This conclusion is also supported by the evidence from leaf counts (*vide* Bulletins 9, 10, 12 and 14). The use of half strength mixture can therefore be recommended with confidence.

Time of Spray.—An inspection of the data given above in table clearly indicates the relative importance of the two sprays. It is clear that the response to the May spray is markedly higher than to September spray. The value of the two sprays is less clear in the case of the 1 per cent twice sprayed blocks and the 1 per cent May sprayed blocks, the difference being very small. In the case of the corresponding half strength spray blocks, the gain from the second spray seems greater. But it must be admitted that this is almost wholly the result of one year's exceptionally heavy crop in the twice sprayed block.

On the whole it seems the gain from the second spray varies very considerably from year to year. The gains from the second spray were experienced in 1931, 1933,

1935 and 1936 while in 1932 and 1934 the blocks sprayed in May only yielded more than the twice sprayed blocks. This can be clearly seen in the table below :—

Treatment	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1% May and September.	3,420	2,945	1,576	2,415	763	2,600
1% May only ...	2,431	3,305	1,144	3,056	571	2,205
½% May and September.	4,942	2,014	2,010	2,408	1,251	3,273
½% May only ...	1,941	3,296	1,495	2,614	691	2,131

The low yields in the twice sprayed plots in 1932 are probably to be attributed to the very heavy crops of 1931. In the case of 1934-35 crop, this explanation will not account for the lack of response to the September spray. It seems that the explanation lies in the peculiar disease conditions experienced in 1933. In this year, the disease situation became extremely severe before the second spray could be applied. It seems likely therefore that the second spray was too late to exert any successful control of the later stages of the attack. The data from leaf counts support this explanation; leaf count observations made in September show, as would be expected, no very marked differences. Similar observations made in February usually show a difference of about 40 per cent in favour of twice sprayed plots. In February 1934, however, the difference was only about 13 per cent indicating that the control exerted by the second spray was greatly reduced in the latter part of 1933.

It remains for future work to indicate whether a second spray may be omitted under certain circumstances. At present, it is considered that the two sprays are desirable though considerable gains will undoubtedly be obtained with one hot weather spray only. In any case it seems more than likely that if the disease situation has already become severe before the end of August, the gains from the second spray will be very slight.

It is interesting to note that apart from the first year the greatest gain from the second spray have been in the

years following the one in which disease attacks were late in showing up. It must be understood that the effects of spray on the yield are experienced only to a very slight extent in the year of application, the main influence being on the crop of the following year.

It is clear from the experience on the Station and elsewhere that the success of the spray varies considerably from year to year. This is in part due to variation in severity of the disease attacks; but also to variation in time of application within the two main spraying periods. In the case of Black Rot, it is clear that the most successful spray will be that which is applied as close to the South West Monsoon as possible thereby protecting the maximum proportion of the total hot weather flush. The situation is complicated in the case of leaf-disease by the fact that the disease is active during the showery hot weather months. Under these circumstances, a late spray may in some years be too late to give effective protection. Evidence discussed elsewhere suggests that the optimum time of spray application lies about a month after the resumption of the active growth in the hot weather. This usually means about 20 days to a month after the blossom showers. It is, of course, not possible to treat any extensive acreage actually within this optimum period, but the evidence reinforces the view that speeding up of the time required for a complete spraying round is likely to lead to considerable improvements in the control of the disease.

In order to study this question more closely, a series of parallel plots were arranged in 1936, each of which is sprayed at a given time after the blossom shower. In all 4 treatments, the first 28 days after the blossom shower and the succeeding ones each a fortnight later have been started. So far no results are available.

Another experiment has been in progress for two years to study the relative value of an early post monsoon spray (late August) compared with a latter one, *i.e.*, (late October)-May spray being constant. No data are as yet available but inspection suggests that on the whole, the earlier spray gives the better results.

Although the results of such experiments cannot be directly applicable to estate conditions, they will indicate what should be aimed at, consistent with the resources of equipment and labour.

Spray equipment.—In the early days of spraying, the machine used was a knap-sack sprayer consisting of a copper cylinder provided with an air pump, a short length of hose and a short lance. The capacity was 2 to 4 gallons of mixture. These proved quite unsatisfactory for dealing with more than a very few acres. To-day they only find use in nurseries or for spraying small areas inaccessible with other spray equipment.

The spraying of large areas was made possible by the introduction of the Drake and Fletcher D.S.P. head-land sprayer. This consists of a double action pump to which are attached long lengths of rubber hose leading to spray lances. This machine works from the roadside and the spraying cooly moves up and down the rows. A number of other machines have been tested but all were on the same principle. These machines fall into two classes:— Hand pumps and motor pumps. The advantages of the hand pumps lie in their portability, simplicity of construction and freedom from mechanical breakdown. Their main disadvantages lie in the larger number of machines required to cover a large area in a reasonable time and the consequent large labour requirement. The advantages of the motor sprayer lie in the speed at which an area can be sprayed, a somewhat smaller labour requirement and a more even maintenance of pressure. The disadvantages lie in their greater weight and size, the greater risk of breakdown and the difficulties experienced in some areas in supplying sufficient water for the output of the mixture at one point.

In order for a motor sprayer to compete in cost with a hand sprayer, it must be capable of working at least 8 lines of hoses.

The earlier tests of machinery have been fully described in Bulletin No. 9. Since that time two new hand sprayers and one motor sprayer have been tested.

Of the two hand sprayers, one proved unsatisfactory being unable to compete in output with the D & F Headland and being subjected to mechanical breakdown. The second, the Craven Headland sprayer compared favourably with the D & F Headland being somewhat lighter and cheaper. Hydralux motor sprayer was one of light and compact construction. At the Station, its output compared unfavourably with the Holder motor sprayer (1934-35).

Beneficial effects of spraying.—

(1) Control of fungus diseases such as leaf disease, etc.

(2) The consequent increase in the amount of foliage and yield.

(3) Borer control.

(4) Weed control.

(5) Less fluctuations in the yield.

(6) Lessening the cost of upkeep.

Future work on spraying.—

(1) The study of the effects of more accurate timing on the control of leaf-disease.

(2) The part played by the nozzles, hose lengths and pressure in the covering power and the efficiency of the spray.

Root-rot.—No effective remedy has so far been discovered to check this disease. At present in the absence of curative or prophylactic methods, precautionary measures are only possible and the spread of the disease is checked by opening deep trenches about two feet deep and isolating the affected plants. Finally the diseased roots should be collected and heaped together and burnt. Root-rot is rather severe on the Station in a few newly planted blocks and is dealt with in the above manner.

Insect Pests.—Neither green bug nor borer are serious pests on the Station. Work on the control of borer has been published in the Entomological Series Bulletin No. 2. Such attacks of green bug as have been experienced have been successfully dealt with by a spray of 2 per cent hongey oil resin soap.

The borer pest is controlled to a very large extent by a systematic removal of trees in good time and their timely destruction (1931-32 Report). Details of borer removed are given in table below. The increase in borer attack during 1934-35 and 1935-36 can be traced to the long drought period experienced after the South-West Monsoon. By adopting the method advised above, it has been found at the Station that the percentage of borer attacked plants is negligibly small, the number being about 1,000 for a total area of 100 acres.

Year	Number of borer removed	Remarks
1930–31 ...	3,730	
1931–32 ...	2,780	
1932–33 ...	1,162	
1933–34 ...	263	
1934–35 ...	389	
1935–36 ...	931	Due to the failure of North-East Monsoon.
1936–37 ...	1,287	do

Miscellaneous experiments.—(1) *Protecting Dadap Stakes (Erythrina Lithosperma) from sun scorching by whitewashing.*—An experiment was conducted to find out an easy and cheap method for protecting Palvan stakes from sun scorching. It is a common experience in new clearings to see many of the stakes succumbing to the heat of the sun. The bark of the stake exposed to the western sun gets browned and scorched. The practice in vogue is to wrap the stakes with banana or alœ leaves to prevent sun scorching. Whitewashing the stakes has shown that this method is cheaper and also very effective as compared to wrapping stakes with leaves. In the plot treated with whitewash 88·8 per cent of the stakes survived as compared to 42·6 per cent in alœ casing and 26·1 of the controls. It is encouraging to note that many planters are adopting this method.

(2) Experiment on germination of Arabica coffee seeds obtained from different sources :—The following Arabica seeds were tested for germination.

(*a*) Seeds of Arabica made in the usual way.
(*b*) Freshly hand pulped beans put into bed with the mucilaginous coating.
(*c*) Seeds collected from bird droppings.
(*d*) Seeds from monkey or other animal droppings.
(*e*) Wet parchment taken out from vats.
(*f*) Dry parchment from store.

Two hundred seeds from each group were taken and put into beds on the same day excepting Item No. (e), under identical conditions. Seeds from bird droppings were the first to germinate and the dry parchment was the last. The percentage of germination is better in the seeds

collected from bird droppings and lowest in the seeds collected from animal droppings. Freshly pulped seeds without being treated in ashes or dried, readily germinated. In case the seeds are not wanted for storing purposes they can be put into beds for germination immediately they are pulped. This will save 8 to 10 days time (1934-35 Report).

(3) *Depth of sowing seeds in beds*:—An equal number of seeds were sown in well prepared beds at the following depths.—½", 1" and 1½". Germination was found to be quickest in ½" sowing and longest in 1½" sowing. For complete germination each series took 76, 96 and 112 days respectively. The same result has been confirmed by a previous experiment. This experiment indicates the importance of depth at which seeds should be sown in beds and any depth beyond ¾" is not conducive to quick germination (Plate No. 9). Besides, if conditions are unfavourable such as excessive dampness of beds, deep sowing is certainly the cause for loss in germination. (1934-35 Report).

(4) *Growth of coffee seedlings in nursery under different soil composition* i.e., *jungle soil and cattle manure*:—It is usual in estates to mix cattle manure and jungle soil in coffee nursery beds and baskets. There are cases where one or the other is wanting to make up the soil. An experiment was put down to find out optimum conditions for plant growth. The following composition of soil and cattle manure were used:—

1.	Only jungle soil (humus)			
2.	Jungle soil and cattle manure		...	1:1 ratio.
3.	Do	do	...	1:2 „
4.	Do	do	...	1:3 „
5.	Do	do	...	2:1 „
6.	Do	do	...	3:1 „
7.	Only cattle manure		...	

The results are as follows:—

It is found that only cattle manure or jungle soil is not conducive to vigorous growth. Plants grown in single medium show pale colouration while the rest had dark green leaves and their height and growth were also markedly superior (Plate No. 10).

Plants grown in medium containing only jungle soil or cattle manure in three parts showed the shortest average growth. Therefore, it seems inadvisable to apply more than adequate quantity of cattle manure for beds or baskets. It is presumable that this result is due to the

effect of too much organic matter in beds causing retention of large amount of moisture. The best proportion seems to be 1 : 1 or 1 : 2 (1934-35 Report).

(5) *Test on the keeping quality of nursery baskets by steeping in copper sulphate solution.*

It has been ascertained by experiments that untreated baskets do not last long enough in the nursery and by the time the plants are ready to be put in the fields they will have nearly or completely been rotted so that in the majority of cases their use becomes a questionable one. Hence an experiment was instituted to find out the effect of copper sulphate solution on the keeping quality of nursery baskets. A series of experiments were conducted in three successive years from 1932 to 1934 and varying strengths of copper sulphate solution from 10 per cent to 2 per cent have been tried. It is found that mere steeping in cold solution does not produce the desired effect. Boiling the baskets in copper sulphate solution for about 3 to 4 minutes is found to be absolutely essential to keep the baskets in tact for over seven months. A two per cent strength is found good to preserve baskets for a short duration and a higher concentration must be used if the baskets are intended to be in the nursery for over seven months. Treated baskets have been recovered in a slightly digested condition after being in the soil for over four months. This illustrates the effect of copper sulphate on the basket tissue. The presence of copper sulphate in the tissue of the baskets inhibits the access of destructive moulds and fungii and hence treated baskets last longer (Plate No. 11). Details of experiments are found in Circular No. 4.

(6) *Methods of planting.*—Coffee seedlings were put in the field in the following manner : (1) Baskets in tact ; (2) Baskets removed ; (3) Root plants ; (4) Bed plants (with ball of earth), (5) Plants removed with the transplanter.

The seedlings taken out from beds in the above manner were planted in the field on the same day and their growth and condition examined at the end of the season. Section planted with root plants looked poor and many vacancies were noticed while in other sections there were not so many vacancies. The above experiment will be tried on a larger scale and the result reported. (1934-35 Report).

(7) *Pruning experiments.*—There are two important schools of thought regarding pruning. One section is of opinion that pruning is essential to maintain coffee bushes in good health and the other believes that no pruning is required and in their opinion coffee does well if not much disturbed. Another view is also expressed that judicious centring is all that coffee requires. At present, much of this work is guided by personal experience and exigencies of circumstances and environmental conditions. Experimental evidence either for or against pruning is still wanting. To clear up misconception and to systamatise, if possible, this part of the work, a series of experiments on pruning were instituted in the year 1933. There are four treatments:—

(1) No pruning, (2) light pruning, (3) Heavy pruning, and (4) handling, consisting of four replications. Thus, we have 16 plots laid out in the manner of a latin square. Crop yields have not revealed significant differences due to difference in treatments. However, there are indications in favour of lightly pruned plots to yield better than either heavily pruned or unpruned plots. This experiment is being continued.

(8) *Growth of coffee in soils burnt to different degrees.*—Definite information on the points whether land (jungle) intended for coffee should be burnt or not is lacking. Although popular opinion is not in favour of it, yet in the majority of cases indiscriminate burning of soil and destruction of vegetation is the rule. It is a well-known fact that injudicious burning of soil leads to wastage of humus content in the soil and eventually lessens its water holding capacity. Experimental plots have been laid out to test the condition of Arabica and Robusta coffee grown on soils burnt to different degrees. In one set of plots the soil has been heavily burnt using logs of wood. Logs were placed side by side and set fire to. The soil when examined later on showed baking into red brick colour from an inch upto a depth of three inches. In light burning only small branches, brush wood, etc. that were left after removing the logs were set fire to and the results recorded. In this case there was no baking but the soil had retained the dull chocolate black colour. The third series is the control plot, which is not burnt to any degree. Robusta and Arabica plants of even size were selected. Owing to the prolonged drought and absence

of shade, there were a few casualties among the seedlings. Results of observation and performance of coffee in these plots observed so far have failed to indicate any differences and perhaps would be observable only when the plants grow up (1934-35 Report).

(9) *Soil Cultivation Experiments.*—Hitherto, soil cultivation methods have not received the attention of the Coffee Station for want of suitable land for experiment. During October 1934 the following series of experiments have been laid out in three repetitions. The land selected cannot be said to be ideal for the purpose, but whatever land was available for experiment has been taken up. Cultivation methods such as deep digging, renovating pits, trenching and light digging are compared with no treatment plots. At present there is a lot of misconception regarding the advisability of the use of any one or more of these practices in particular soils and environmental conditions. Soil cultivation in the manner suggested above is believed to ameliorate the physical conditions of the soil and improve tilth and water holding capacity which have a bearing on the health of coffee trees. "Cold feet of Coffee" in excessive wet soils is a frequent cause of leaf drop and subsequent "Die-back". The present series of experiments are designed to study and investigate matters connected with individual practice in relation to health of coffee and optimum soil conditions for its growth. The indication of results so far available are (a) that trenching is beneficial in clay soils to avoid water-logging and "wet feet" for coffee and (b) that digging is not necessary and may even be harmful for Robusta coffee, a conclusion drawn from a preliminary study of root system of the different varieties and (c) that mulching is beneficial for all purposes.

Root Studies.—A Study of the root system of coffee plants has shown that Robusta is a surface feeder. The same study has indicated that root system of a resisting hybrid and a susceptible Arabica growing under identical conditions show extraordinary differences in the development and penetration (Plate No. 12, 35-36 Report). Details of this study will be published in the next report.

Blossom Setting.—The effect of continued or intermittent showers on the coffee blossom and fruit setting was one of the studies begun to verify the belief that such showers would increase enormously the percentage of 'jollus' or 'lights' in that year's crop. It is yet too early

to say anything definite on this question as the experiments are not concluded.

Fruit Cultivation.—In many coffee estates different varieties of fruits are being grown but generally preference is given to the cultivation of oranges. Even small garden owners possess a few orange trees from which they earn a decent income. As a subsidiary industry, citrus cultivation has great possibilities in coffee estates. Certain parts of malnad in the Kadur and Hassan Districts, notably Aldur, Gonibid, Anughatta, Chinnuga, Saklespur, etc., are noted for the quality of oranges they produce in large quantities. There is a ready market for the fruits grown in these places. Therefore, it was thought desirable that the coffee experiment station should take up some work on fruit cultivation without prejudice to its normal work. Hence preliminary work in this connection was first taken up in the year 1933. Although several kinds of fruits have been planted on the Station to study their performance under malnad condition, particular attention is paid to oranges and pine-apple. The aim of the Station in having taken up this branch of work is to study the following problems among other things. The broad lines of work on which studies have been commenced are as follows :—

(1) Collections of citrus varieties and their study.
(2) Methods of propagation, layerings, budding, grafting and cuttings and study of seedlings.
(3) Study of suitable stocks for budding and grafting.
(4) Diseases and pests.
(5) Manuring.
(6) Methods to control time of blossoming.

Besides it should be possible for the Station to supply planters grafted and budded plants in time to come. Preliminary work in collecting varieties of oranges both local and foreign was commenced during 1933-34. The collections so far made include the following and their number is given in parenthesis.

Local type :—

Yemmedoddi	...	100 seedlings.
Coorg	...	125 „
„	...	57 layerings.
Saklespur-Coorg	...	1 layering from selected tree.
Anughatta	...	2 grown from cuttings ni propagator.

Yemmedoddi Budded	...	(5) on Pommelo stocks.
		(3) on Coorg seedlings.
North India—1935—	....	Nagapur Oranges (2) grafted.
		Sathkadi (2) ,,
Foreign variety planted during 1935.		Malta blood (2) ,,
		Mozambic (2) ,,
		Valentia (6) ,,
		Washington Navel (6) ,,
		Pommelo :—Devanahalli variety (6) seedlings.

It is comtemplated to obtain some more local and exotic varieties for comparative study as and when funds permit.

For purposes of grafting and budding three kinds of root stocks have been raised in the nursery, *viz.*, Pommelo, Sour orange and Doddali and this work will be taken on hand very early. Preliminary work on all the items proposed have been taken up. We have seedlings of Yemmedoddi and Coorg oranges. Layered Coorg Orange has been obtained from Saklespur and cuttings brought from selected mother plants from Anughatta have struck roots. Bud-wood was obtained from selected mother plants from Yemmedoddi and the buds were grafted on to Pommelo and seedling Coorg Orange stocks. All the five successful buds on Pommelos are showing signs of dwarfing or incompatibility and although they are nearly two years old, yet growth is markedly slow. Those are budded on Coorg Orange seedlings have come up very well. This point remains to be investigated. A few Coorg buds inserted on Pommelo stocks are showing comparatively better growth than Yemmedoddi. Large scale budding will be taken up very shortly with the budwood obtained from best selected Coorg and Yemmedoddi mother plants.

The possibility of growing orange cutting in a Solar Propagator has been investigated and the results are encouraging. Marcotting has also been done very successfully and have been obtained from three-year old Yemmedoddi and Coorg seedlings. These two methods will serve to multiply the desirable mother plants and the first method described seems to be more valuable in that greater number of trees can be raised by rooting small cuttings in the propagator.

Insect and fungoid pests are common. Green and brown bug pests are treated with hongey oil resin soap. Mildew is not severe on the Farm. This can be controlled by bordeaux oil spray at frequent intervals from early November up to end of December. "Yellowing" is fairly frequent and spraying with Zinc Sulphate with an adhesive in the proportion of 10 lbs. of Zinc Sulphate to 5 lbs. of lime in 100 gallons of water seems to check it.

Pine Apple.—Six suckers of each of Kew, Queen and Mauritius varieties of pine apple (Ananas) were obtained from Marthur Farm in 1934. In addition 25 suckers of Queen variety were got from Gangenahally Farm during 1935. All the three varieties have yielded fruits, the size and quality being satisfactory. The Kew variety has smooth leaves without serrated margin (saw edge) and the fruit produced is much larger than other kinds. All the available suckers have been planted out. It is proposed to distribute suckers for planting purposes as soon as sufficient numbers are available.

It is to be mentioned here that pine apple seems to be a hardy fruit and on the farm no special treatment either of irrigation or manuring has been given and yet good sized fruits have been obtained. Suckers have been planted in beds in the open and they are coming up well.

Other fruits planted include the following grafted varieties, *viz.*, apple, pomogranates (Kabul and Patna varieties), Allahabad Goas, Sapodilla and three varieties of mangoes. Several kinds of plantains that were planted are not thriving well due to want of irrigation. Cashewnut plants about 85 in number are doing well. Tungoil plants (Aleurites Fordii) are very slow in growth and the few plants that are surviving are not thriving well.

Cardamom.—Five upright and five trailing varieties of cardamom have been collected from cardamom growing areas of Mysore, Madras and Bombay (Bulletin 8) and all the varieties are now bearing. Forty plants have been selected and their yield record is being maintained. Breeding work on the good bearers among these will be taken up shortly (Plate No. 13).

Pepper.— Kalluvalli and Balamkottah varieties noted for their yield and quality have been obtained and planted. These will be multiplied for distribution.

Field Day and Visitors.—A Field Day was held on the 27th November 1934 under the Presidentship of *Rajamantrapravina* S. P. Rajagopalachari, Member of Council. Planters were taken round the experimental plots in batches and the nature of experiments were explained to them. Demonstrations were also held for their benefit on spraying, grafting, etc. There were discussions on subjects of interest to planters in which the staff of the Department, Scientific Officer and the planters took part. The Station continues to attract many planters and scientists working on coffee problems both from India and abroad, and other distinguished visitors.

Training Courses.—A number of writers and maistries sent by the planters to undergo training in spraying and grafting, etc., at the Station took advantage of short courses. Four such courses were held in the years 1931 to 1934.

Publications.—Apart from the publications from the Department as many as 14 bulletins and four circulars have been published by the Station. The details are found in Appendix 1.

Education of Children.—A primary school is being run from this year for the benefit of children of the staff members and of the labourers. The children from neighbouring estates and villages are also taking advantage of the school. A night school is also being held for the benefit of the adults. The Kadur District Board has very kindly lent the services of a teacher for this school.

Coffee yield and realizations.—The average yield for the past four years from 1931-32 to 1935-36 has been 12 tons, 15 cwts, and 3 Qrs. and the yield per acre works up to 4 Cwts. as per statement (considering the experimental area only); the outturn *viz.*, the number of bushels of parchment and cherry to make up a ton of clean coffee was 89 and 125·7 respectively, the minimum figure for these being 81·48 and 112·55 respectively. Considering the locality, low elevation and poor type of soil, the yield per acre and the outturn in the opinion of the planters, are very encouraging. The realizations which are low in the past three years due to the general depression are showing signs of improvement.

COFFEE.

Year	Yield				Net realizations	Out turn			
						Parchment		Cherry	
	Tons	Cwts.	Qrs.	Lbs.		Maximum	Minimum	Maximum	Minimum
					Rs. a. p.				
1932-33 ...	15	2	2	3	13,579 8 6	89·40	81·48	119·16	112·55
1933-34 ...	12	15	1	7	9,323 1 6	89·75	86·97	130·47	122·62
1934-35 ...	13	0	1	17	9,366 15 8	88·14	87·27	130·0	124·6
1935-36 ...	8	4	2	27½	4,226 10 0	...	...	123·23	...
1936-37 ...	13	18	...	...	.....	...	...	...	...

Cardamom.		lbs.	Rs. a. p.
1934–35	...	32	17 5 10
1935–36	...	31	49 12 9
1936–37	...	69½	158 14 0

V. Agricultural Meteorology.

A third class Meteorological Observatory was started in September 1929, with the object of correlating the climatic data with the diseases and pests of coffee and only one set of observations were being taken at 0830 hrs. Local Time. When Agricultural Meteorological studies were newly started in November 1935, the ordinary meteorological data were found totally inadequate to attain the objects with which the observations were commenced. Great necessity for Agricultural Meteorological instruments is being felt to fully investigate the problems connected with coffee and climate, in view of the fact that weather influences the crop and its diseases at every stage of their growth.

Observations and studies on some of the problems with the equipment available were started on the experimental as well as the statistical side of agricultural meteorology and valuable data are being collected for study. A Campbell-Stokes Sunshine Recorder was newly installed in November 1935 and records of duration of bright sunshine are being taken daily. Such records are necessary for a scientific study of problems particularly connected with shade and its regulation in Coffee Plantations. Also, from November 1935, three extra sets of

observations of weather elements are being taken to study the climatic changes in the afternoons as affecting coffee.

The laboratory of the Government Coffee Experiment Station, Balehonnur (Lat. 13°22′ ; Long. 75°28′) is situated at a height of 2914 feet above mean sea level. The coffee plantation belonging to the experiment station ranges in height from 2725 to 2945 feet; the major portion slopes gently to the north-east.

Before reviewing the weather changes from year to year, the general climate of this locality based on the meteorological observations of the past five years from 1932 to 1936 is very briefly described below.

The average annual rainfall of this Station is 105 inches (Table I) and varies from 93 to 119 inches (Table 2). More than 70 per cent (73·54 inches) of this rain is contributed by South West Monsoon in the three months of June, July and August. This Monsoon sets in usually about the first week of June and withdraws itself about the last week of September. July is the wettest month with nearly 33 per cent (34·25 inches), August coming next in rank with 20 per cent (21·37 inches) of the total rainfall (Table 1). It is very usual to measure heavy rainfalls of four to six inches per day in the midst of the Monsoon for a few days. Tenth of July 1932 has been the wettest day on record since 1932 with 6·60 inches of rain.

Thunderstorms occur in the months of March, April and even May in the pre-monsoon period mostly in the afternoons and in the months of September, October and November after the Monsoon withdraws itself. Hailstorms also occur in the months of March, April and May, which cause at times some damage to the plantations for the hailstones will be asbig as 1 to 1½ centimeters in diameter.

The North-East Monsoon contributes very little rain for this area. This sets in usually in November and prolongs till about the middle of December.

This place is comparatively very cool, the average annual maximum and minimum temperatures being 80·2° F and 63·7° F respectively (Table 1). The highest and the lowest temperatures recorded since 1932 are 94·7°F and 50·0° F respectively on 30th March and 10th November 1934 (Table 3). The afternoon temperatures are low in November and December and high in March and April. But the latter months are quite pleasant due to

the cool sea breeze that sets in usually in the afternoons. The night temperatures are very low in December and January and moderately high in April and May. The diurnal range in temperature is high from December to March during which period thick radiation fogs are of common occurrence in the evenings, nights and early mornings. With the onset of the monsoon, the diurnal range is reduced and monsoon fogs become frequent which at times are much thicker than radiation fogs. Dew formation is very common particularly in the cold and hot seasons.

Though the average monthly relative humidity of the air is nearly constant, the fluctuations from morning to the afternoon is very great, particularly in the months December to March, when it often varies from nearly saturation in the early mornings to 8 to 9 per cent in the afternoons.

The average duration of bright sunshine per day during the year 1936 was 5 hours 57½ minutes, the longest duration being in January and the shortest in July. On an average, there was sunshine for a longer interval in the forenoons than in the afternoons in all months excepting February to May and in August. This is particularly so in the months of September, October and November. The belief that western slopes are harmful for plantations was true only to that extent that in greater portion of the summer months *viz.*, February to May, plants on western slopes were exposed for a longer interval than those on the eastern slopes. A more detailed study is being done on this particular aspect of the question.

The year for coffee may be said to commence from the very first thunderstorm showers named by coffee planters as Blossom Showers as these bring out the blossom. Blossom showers rarely fail but may be untimely, irregular or inadequate. Experience of these years have shown that Hybrids require a very high rainfall for satisfactory blossom whereas Robusta requires minimum quantity of rainfall. Experiments on the water requirements for successful blossoming for the different varieties are planned for the coming season. Climatic conditions in this critical period are known to greatly influence the yield and diseases of coffee. Observations have shown that normally the yield of one year is influenced to a greater extent by weather conditions of the previous year, whereas the diseases (particularly the leaf-

disease) are influenced more by climatic conditions of the current year. Moisture conditions in the pre-monsoon period and sunlight conditions in the period of the two monsoons have been found to be the two most important factors in influencing the health and yield of coffee plants. Also observations by Mr. W. W. Mayne, the Coffee Scientific Officer, have shown that " the weather conditions between January and the begining of monsoon are of the greatest importance in determining the severity likely to be attained by leaf-disease in the latter half of the year ". Intermittent showers and bright sunshine in the pre-monsoon period are greatly responsible either in starting or in aggravating the leaf-disease.

It has also been definitely known that dew plays a very important part from the leaf-disease point of view. But unfortunately no regular observations are being made for want of instruments.

Climatic conditions in the North-East Monsoon period particularly in the first half of the period, is known to greatly control the severity of the borer pest for the coming year.

Having described briefly the general climate of this locality as affecting coffee, weather changes from year to year from 1932 to 1936 are very briefly dealt with below.

1932.—The general condition of coffee early in the year was good. Satisfactory blossom showers fell (1·19 inches from 4th to 6th and 0·23 inches from 12th to 14th April) and prospects of coffee crop were better than in 1931. The S.-W. Monsoon set in about the 6th of June but some heavy showers associated with a temporary advance of the monsoon about the middle of May fell. The monsoon remained weak in June but strengthened in July, the total rainfall for July being 40·67 inches. Due to heavy rains coffee suffered from Black Rot. November was the wettest due to the active N.-E. Monsoon. This caused Black Rot to continue to appear till late in the year. This year was also a bad Borer year due to the previous dry N.-E. Monsoon period, the total number of borer attacked plants removed was 1,162 for about 80 acres. The crop picked, however, was 15 tons 2 cwts. 2 qrs. which was mainly due to the favourable conditions of climate in the previous year.

1933.—Blossom showers were very early and irregular (0·26 inches on 28th February few showers later on) ; and further light showers at frequent intervals in March

caused irregular and uneven blossom, which introduced difficulty for crop estimation. The S.-W. Monsoon set in about the middle of May earlier than usual and was very active till the middle of October. May, which was the wettest on record for the State since 1893, was also the wettest here. The monsoon continued longer than usual with the result that October also, which became similarly the wettest on record for the State, and for Kadur District since 1893, was also the wettest October for this place. The consequence of this heavy monsoon was that coffee suffered much from Black Rot and Dieback, particularly from the latter, not only in this locality but in almost all coffee districts. Investigations by Messrs. K. H. Srinivasan, W. W. Mayne and M. J. Narasimhan on the cause for severity of this disease and for the reported failure of spraying against these diseases in this year have already appeared in Circular No. 1. The N.-E. Monsoon was definitely weak this year and the number of borer attacked plants removed were only 263. The crop picked was 12 tons, 15 cwts, 1 qr. and 7 lbs.

1934.—This year was equally unfortunate, the blossom showers (0·54 inches on 17th March and 0·31 inches on 10th April) being inadequate and ill-distributed to open all the buds. The monsoon set in at the usual time but was comparatively weak in the second and third weeks in June and July. This mild and broken monsoon affected by aggravating the intensity of leaf-disease, which had not only favourable climatic conditions in the pre-monsoon period but also had a great carry-over of disease from the previous year. The N.-E. Monsoon also was definitely weak. This resulted in not only poor growth of new wood but favoured insect pests for this year and the borer for the next year. The number of borer plants removed was 389 and the crop picked was 13 tons 0 cwt. 1 qr. and 17 lbs.

1935.—Blossom showers in this year was in no way better for besides being irregular (0·26 incs. and 0·20 inches on 28th and 30th March); 1·68 inches from 3rd to 6th April) early showers of 7 cents on 30th and 31st January had already caused slight blossom. The monsoon set in about the 12th of June, later than usual and was very active in July and in the second half of August. This heavy rain increased Black Rot in some of the areas. July was the wettest on record since 1932 with a total rainfall of 42·69 inches. The N-E. Monsoon was weak in this year and

the borer plants removed was 931. The crop picked was 8 tons, 4 cwts., 2 qrs. and 27½ lbs.

1936.—Fortunately 1936 was a good year with adequate and timely Blossom Showers (0·18 inches on 18th March and 2·72 inches from 20th to 23rd March) and the monsoon set in about the usual time. But one of the most severe storms that this Station in particular and the coffee area in general ever experienced did much damage to the estate and to the buildings in the last week of June. This caused the month of June to be the wettest on record, the total rainfall being 26·61 inches out of which the storm contributed as much as 19·15 inches from 24th to 30th June. Twenty-seventh of this month was the day when greatest damage was done by the storm. Some showers fell in December which caused some slight damage in this locality and greater damage in other areas to the standing crop by causing splitting and falling off of the ripe fruits. The number of borer attacked plants removed was 1,312 and the crop picked was about 13 tons.

The problems that are under investigation are :—

(1) The periodicity and the rate of growth of coffee plants in relation to weather.

(2) A detailed statistical study of rainfall conditions in coffee area of Mysore State, as affecting the coffee crop.

(3) Uniformity trials in coffee estate to investigate the errors involved in all field experiments and their relation to plot size and shape.

(4) Soil moisture studies—as affected by weather conditions and its relation with mulching, shade, pruning etc., in coffee plantations.

(5) Effect of climatic conditions on the drying of coffee.

(6) Study of leaf fall from coffee plants.

(7) Study of root systems of coffee plants.

(8) Statistical study of the experimental data collected at the Station.

As these studies were commenced only recently, the results would be published after some more data are collected and studied. Problems that will be taken up are :—

(1) Microclimate of coffee plantations.

(2) Water requirements for blossom.

TABLE (1)— Mean monthly and annual maximum and minimum Temperature Rainfall, number of Rainy days (Mean of five years 1932-1936) and th duration of Bright Sunshine for 1936.

Months	Temperature in °F		Rainfall in inches	Number of rainy days	Duration of sunshine in hours per day
	Maximum	Minimum			
January	80·9	58·9	0·08	..	8 96
February	83·8	60·1	0·10	...	8·35
March	87·5	63·5	1·49	3	7·87
April	87·3	66·2	2·54	6	8·43
May	84·7	67·5	5·51	9	6·22
June	76·6	66·0	17·92	22	2·06
July	73·2	65·7	34·25	27	1 40
August	74·7	65·7	21·37	24	2·52
September	76·2	64·7	9·88	20	5·02
October	79·1	65·2	8·89	12	5·24
November	79·0	61·4	2·47	4	6·69
December	79·1	59·0	0·15	1	8·66
Year (1932-36) ...	80·2	63·7	104·65	128	5·95

TABLE (2)—Monthly Rainfall from 1932 to 1936, number of Rainy Days (mo than 10 cents) and the Greatest Rainfall per day for each of the years. (Rain days are given within brackets.)

Months	1932	1933	1934	1935	1936
	Inches	Inches	Inches	Inches	Inches
January	0·00 (—)	0·00 (—)	0·34 (1)	0·07 (—)	0·00 (—)
February	0·00 (—)	0·26 (1)	0·00 (—)	0·00 (—)	0·24 (1)
March	0·03 (—)	2·89 (5)	0·54 (1)	0·46 (2)	3·54 (7)
April	4·11 (8)	3·71 (8)	1·23 (4)	1·82 (4)	1·81 (6)
May	8·98 (12)	9·68 (10)	2·11 (3)	1·30 (4)	5·49 (15)
June	8·32 (19)	23·68 (26)	18·85 (18)	12·18 (16)	26·61 (30)
July	40·67 (27)	32·33 (27)	29·72 (25)	42·69 (28)	25·83 (31)
August	21·18 (21)	19·95 (19)	27·20 (26)	18·56 (23)	19·95 (29)
September	12·79 (22)	13·50 (23)	4·30 (15)	10·32 (15)	8·50 (23)
October	9·19 (14)	11·68 (16)	7·71 (8)	6·62 (11)	9·26 (13)
November	8·30 (9)	1·07 (2)	0·60 (3)	0·11 (—)	2·26 (7)
December	0·05 (—)	0·55 (2)	0·00 (—)	0·10 (1)	0·04 (—)
Greatest Rainfall per day in the year ...	6·60 on July 10	4·60 on June 17	5·21 on July 5	4·80 on July 11	4·62 on June 27
Total ...	113·62 (132)	119·25 (139)	92·60 (104)	94·23 (104)	103·53 (162)

TABLE (3)—Monthly mean maximum and minimum Temperatures from 1932 to 1936 with the highest and lowest Temperatures recorded in each year.

Months	1932		1933		1934		1935		1936	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
	°F		°F		°F		°F		°F	
January ...	79·8	56·7	80·7	58·1	80·9	60·0	81·1	59·6	81·8	60·3
February ...	82·2	58·5	84·4	61·9	85·0	59·3	85·3	60·9	82·0	59·9
March ...	88·3	63·4	86·7	63·6	88 0	62·8	87·2	63·3	87·4	64·4
April ...	87·2	66·5	37·8	66·5	87·8	66·7	87·7	65·2	86·1	66·2
May ...	82·6	67·3	82·9	67·0	86·9	67·5	86·8	68·1	84·1	67·6
June ...	76·8	66·1	75·0	65·7	77·3	66·2	78·9	66·5	75·2	65·3
July ...	73·7	66·1	73·6	65·6	73·1	65·7	72·7	65·7	72·8	65·6
August ...	77·8	66·5	75·6	66·1	72·8	65·8	73·6	65·1	73·5	65·2
September ...	75·4	65·3	76·1	64·9	75·7	64·1	75·0	63·5	78·7	65·5
October ..	79 0	65·9	78·1	64·0	80·0	65·2	79·1	65·1	79·5	65·6
November ...	78·3	62·8	80·1	61 9	78·2	59·0	79·6	60·2	78·9	63·3
December ...	78·4	57·8	78·2	58·2	78·6	58·3	80·2	60·8	80·2	60·1
Year ...	80·0	63·6	79·9	63·6	80·4	63·4	80·6	63·7	80·8	64·1
Extreme temperatures recorded.	93·3 on March 22	53·2 on Feb. 6	93·9 on March 4 & 8	52·0 on Dec. 29	94·7 on March 30	50·0 on Nov. 10	93·1 on April 18	52·6 on Jan. 4	93·0 on May 5	51·0 on Dec. 31

ERRATA.

Plate No. 10 referred to on page 26 has been excluded from the bulletin.

WD 2089—GPB—1,500—9-9-38.

THE MYSORE COFFEE EXPERIMENT STATION PUBLICATIONS

(a) Bulletins.

1. The Mysore Coffee Experiment Station ; what it is doing for the improvement of Mysore Coffee.
2. The Coffee Berry Borer (Stephanoderes hampei) a Preliminary Account.
3. Report of work on the Coffee Experiment Station, Balehonnur for the years 1925-30.
4. Seasonal periodicity of the Coffee Leaf-disease (Hemileia-vastatrix B. and Br.).
5. Annual Report of the Coffee Scientific Officer, 1930-31.
6. Seasonal periodicity of Coffee Leaf-disease (Hemileia-vastatrix B. and Br. 2nd report).
7. Annual Report of the Coffee Scientific Officer, 1931-32.
8. Report of the work on the Coffee Experiment Station, Balehonnur, for the years 1930 and 1931.
9. Spraying of Coffee in South India.
10. Annual Report of the Coffee Scientific Officer, 1932-33.
11. Nematode worms in relation to the Cockchafer and Mealy Bug Problem in Coorg.
12. Annual Report of the Coffee Scientific Officer, 1933-34.
13. Do do 1934-35.
14. Do do 1935-36.
15. Factors affecting spray success in the control of coffee leaf-disease.
16. Annual Report of the Coffee Scientific Officer, 1936-37.

(b) Circulars.

1. Report on the Disease Situation in Coffee Areas in 1933.
2. Vegetable oils as spreaders for Bordeaux mixture.
3. Preservation of Nursery baskets (Cir. 4).

Publications of the Department of Agriculture on Coffee.

General Series.

1. Coffee.—Its cultivation and manuring in South India.
2. Improvement of the Coffee Industry in Mysore.
3. Improvement of Coffee in the Dutch East Indies.
4. Report on the Coffee Berry Borer, Stephanoderes hampei in Java.

Mycological Series.

1. Black-rot or Koleroga of Coffee in Mysore.

Entomological Series.

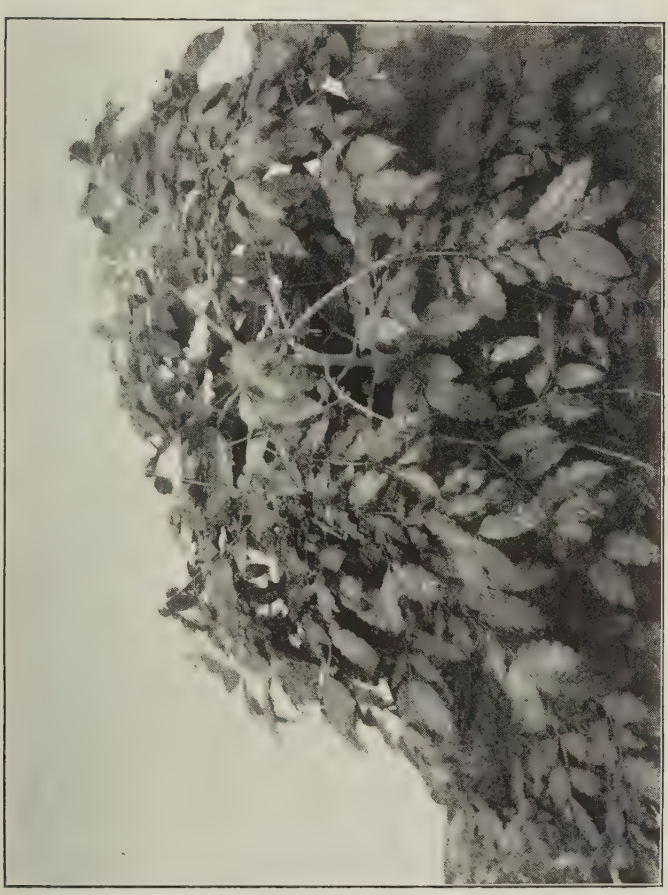
Bulletins.

1. Some Scale Insect Pests of Coffee.
2. The Coffee Stem Borer.

Four Circulars.

S. 26. Mother Plant. -9 years. (Top view.)

Mother Plant. S. 44.—8 years.



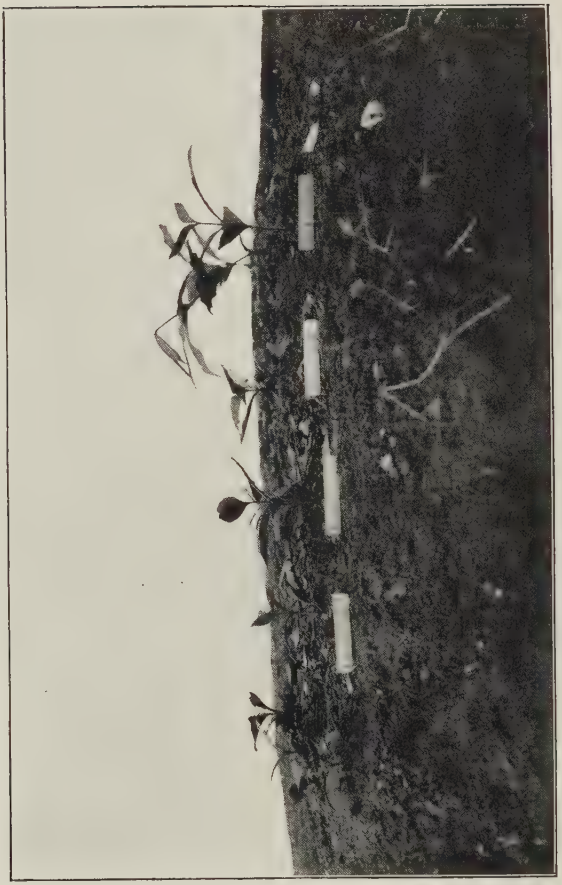
F_1 of S. 26.—5 years.

F_1 of (S. 26 X Robusta.)—4 years.

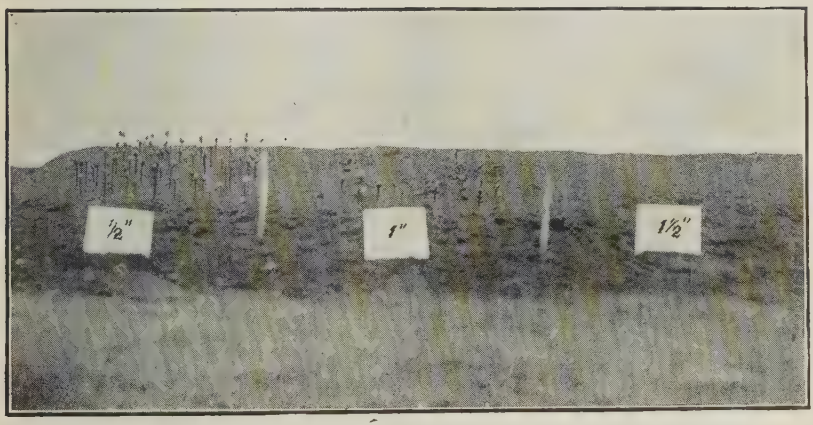
F_1 of S. 44.—4 years.

Graft with primary branches as scion wood.—3 years.

Root cuttings of Robusta and Arabica Coffee.



Plants raised from leaf cuttings.—1 year.



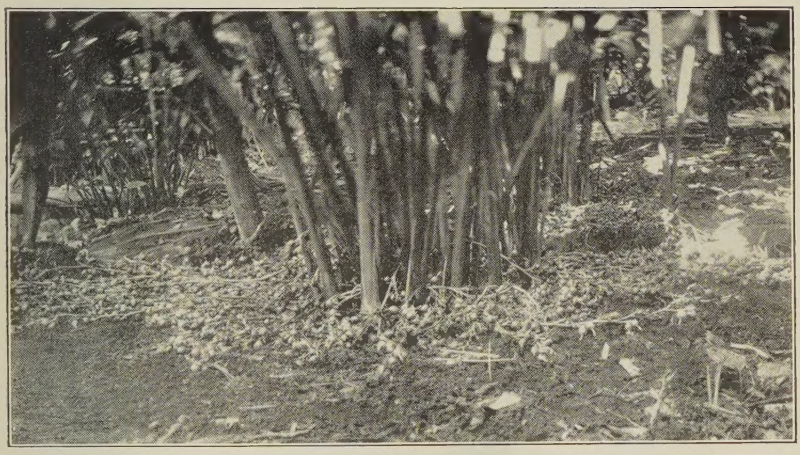
Depth of sowing seeds in beds.

Baskets treated with Copper Sulphate and untreated ones.

Root system of Robusta Coffee.—6–7 years old.

Root system of Arabica Coffee.—6–7 years old.

Root system of Arabica Hybrid.—6–7 years old.



Cardamom—Trailing.

Cardamom—Upright.